



## Internal Reflection Sensor for the Cone Penetrometer



**Developer:** EIC Laboratories, Inc.  
**Contract Number:** DE-AR21-96MC33079  
**Crosscutting Area:** CMST

Subsurface  
Contaminants  
FOCUS AREA

### Problem:

Non-aqueous phase liquids (NAPLs) are environmental contaminants of particular concern because of the long-term threat they pose to drinking water supplies. NAPLs such as trichloroethylene, perchloroethylene and gasoline have low water solubilities and therefore, as "free phase" contaminant sources, are depleted only very slowly by dissolution into large volumes of groundwater. The result is widespread pollution that can continue for many years if the NAPLs are not located and removed. Locating NAPLs is a

challenging task because they migrate through cracks and fissures in the subsurface soil to form small, isolated "pools" of contamination.

### Solution:

Develop a rugged, inexpensive sensor that can be deployed in a cone penetrometer, for real-time detection of NAPLs, during site characterization.

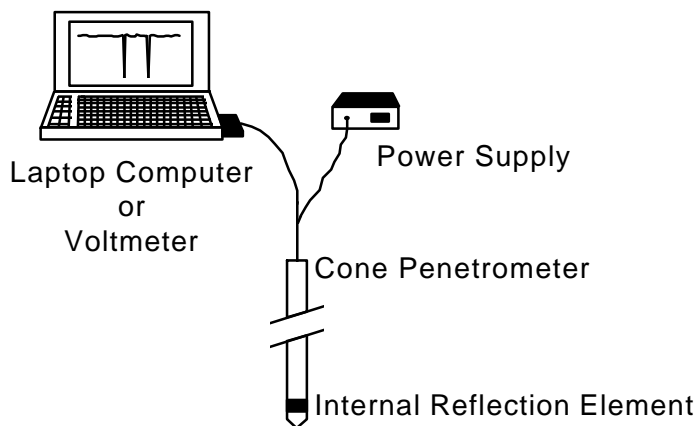
### Benefits:

►Meets sensing need for which no technology currently exists

►Improves the quality and reduces the time and cost of site characterization

### Technology:

The heart of the sensor is the internal reflection element. This element is positioned in the wall of the penetrometer cone so that its sensing face is in contact with the soil or groundwater as the cone is pushed into the ground. When no contaminants are present at the sensing face, laser light is fully reflected within the element and is detected in the sensor head. However, when NAPLs come into contact with the sensing face, the internally reflected light is diminished. This results in a decrease in the signal output by the detector - a positive indicator of NAPL presence. Because the response from the detector is continuously measured at the surface by a voltmeter or computer, NAPLs can be detected instantaneously. An important feature of the device is response only to NAPL contaminants, without interference from natural soil components, groundwater or dissolved chemicals. The sensor operates in both the vadose and saturated zones. This project is planned in two phases



to demonstrate internal reflection sensing as a viable technique for locating NAPLs in the subsurface. Phase I includes the fabrication and laboratory testing of the internal reflection sensor. Phase II will demonstrate the technology in a cone penetrometer at a site contaminated by NAPLs.

DOE Project Manager:  
Mr. Jagdish L. Malhotra  
Federal Energy Technology Center  
3610 Collins Ferry Road  
P.O. Box 880  
Morgantown, WV 26507-0880  
Phone: (304) 285-4053  
Fax: (304) 285-4403  
E-mail: jmalho@fetc.doe.gov

## Contacts:

EIC Laboratories, Inc. develops sensors for environmental and other applications, including hazardous waste site characterization. For information regarding this project, the contractor contact is:

Principal Investigator:  
Dr. Job Bello  
EIC Laboratories, Inc.  
111 Downey Street  
Norwood, MD 02062  
Phone: (617) 769-9450  
Fax: (617) 769-2099  
E-mail: None

DOE's Federal Energy Technology Center supports the Environmental Management - Office of Science and Technology by contracting the research and development of new technologies for waste site characterization and cleanup. For information regarding this project, the DOE contact is:

